



SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
[DEEMED TO BE UNIVERSITY]**

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SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF CHEMISTRY

1.2.1 New Courses Introduced in 2022- 2023

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SCYA5204	Computational Chemistry	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concept of computational chemistry built for a simple system.
- To comprehend the concept of Variation theory for Density-Functional theory (DFT)
- To realize the basic construction method of “Density-Functional theory” using quantum mechanics.
- To build up the subject related concepts to approach contemporary methods.
- To get familiar with the recent approaches of molecular dynamic methods.

Unit-1: Introduction to Computational Chemistry

12 Hrs

The promise of computational chemistry, potential energy surfaces, computational strategies-coordinate systems, geometry optimization, local and global minima, conformational analysis, transition state optimization, saddle point, vibrational frequencies. *Case study: Predict the local and global minima of benzene molecule using structural and energy values.*

Unit-2: Computational Chemistry methods

12 Hrs

Molecular Mechanics-Force field methods, Semi-empirical methods, Variational method, Roothaan-Hall equations, self-consistent field approach, electron spin and Pauli principle and Slater determinants.

Unit-3: The Quantum Theory

12 Hrs

The Perturbation theory. *Ab initio* methods- Basis sets, Slater and Gaussian functions, polarization and diffuse functions, split-valence sets, correlation-consistent sets, Born-Oppenheimer approximation.

Unit-4: The Hartree–Fock method and beyond

12 Hrs

Hartree-Fock theory, electron correlation problem, Koopmans theorem. Density Functional Theory (DFT) and methods.

Unit-5: Molecular Dynamics Simulations

12 Hrs

Basic principles-Equations of motion, force calculations, integration schemes, boundary conditions, phase space and distribution functions, time step and time scale considerations, stability, Practical aspects of simulations, *ab initio* molecular dynamics.

COURSE OUTCOMES

Upon completion of the course the students will be able to

CO1: Examine the significance of computational chemistry to chemical systems.

CO2: Interpret the currently available high-performance computational chemistry methods.

CO3: Analyse the solutions for Chemical problems by using computational thinking.

CO4: Evaluate the structural parameters of chemical systems by computational techniques.

CO5: Compare the various theory available in computational chemistry software.

CO6: Implement the programming skills in computational chemistry field.

TEXT / REFERENCE BOOKS

1. Quantum chemistry, Ira N. Levine, Brooklyn, New York.
2. F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2003
3. C. J. Cramer “Essentials of Computational Chemistry”, 2nd ed., Wiley 2004.
4. Foresman, J. B.; Frisch, A.E. Exploring Chemistry with Electronic Structure Methods, 3rd ed.
5. Gaussian, Inc.: Wallingford, CT, 2015. (See also: <http://expchem3.com/>) User manuals of Gaussian09.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A : 6 Questions each carrying 5 marks without choice

30 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 14 marks

70 marks

(Out of 100 marks, maximum of 10% problems may be asked)

SCYA 6203	Computational Chemistry Lab	L	T	P	Credits	Total Marks
		0	0	3	2	100

COURSE OBJECTIVES

- To understand the basic concept about how to built for a simple system in computational chemistry visualization software.
- To understand the concept of energy optimization in Density-Functional theory (DFT)
- To understand and analyse the orbitals of a molecule.
- To understand and analyse the spectroscopic properties for a given molecule.
- To get familiar with the recent approach of other computational theory.

The list of probable experiments is mentioned below, which delineates the experiment to be performed in a semester. Any seven experiments can be selected from the list.

List of Experiments

Exp-1: Construction of the molecular structure of small molecule like H₂, CH₄, CO₂ by Gauss View software.

Exp-2: Design the method for calculating the lowest energy structure of small molecule like H₂, CH₄, CO₂ by Gaussian software.

Exp-3: Execute the orbital analysis of a given structure by Gaussian software.

Exp -4: Interpret the vibrational frequency spectrum of small molecule like H₂, CH₄, CO₂ by Gaussian software calculation.

Exp -5: Implement the geometry optimization process of a given small molecule like H₂, CH₄, CO₂ by other computational theory by Gaussian software.

Exp -6: Construct the structure of organic molecule by Gaussian software and evaluate its properties by geometry optimization process.

Exp -7: Construct the structure of transition metal complex by Gaussian software and evaluate its properties by geometry optimization process.

Exp -8: Investigate the absorption spectra for fullerenes by Gaussian software.

Exp -9: Construct the structure of polymer material by Gaussian software and evaluate its properties by geometry optimization process.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Construct the molecular structure of chemical compounds.

CO2: Develop the skill for geometry optimization process.

CO3: Identify the molecular orbital diagram of molecules computationally.

CO4: Interpret the vibrational spectra of chemical systems computationally.

CO5: Investigate the absorption spectra for solar cell materials.

CO6: Implement the knowledge of Gaussian software for real world problems.

TEXT/REFERENCE BOOKS

1. Warren J Hehre, Laboratory book of computational organic chemistry, wave function, 1998.

2. Tim Clark, A Handbook of Computational Chemistry: A Practical Guide to Chemical Structure and Energy Calculations, Wiley Black Well, 1985.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 50

Exam Duration: 3 Hrs

CAE Evaluation of Regular Lab class 25 Marks

50 Marks

Model practical exam 25 Marks

ESE University Practical exam

50 Marks

SCYA 3002	FUNDAMENTALS OF SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To study the interaction of radiation with matter and selection rules
- To learn the fundamentals of spectroscopic techniques
- To understand the principle and instrumentation of various spectroscopic techniques
- To interpret the spectra of various spectroscopic techniques
- To apply the concept of spectral data to assign the structure of organic compounds

UNIT 1 INTRODUCTION TO SPECTROSCOPY

9 Hrs.

Interaction of radiation with matter – Electromagnetic spectrum – quantization of energy – Boltzman distribution (formula only) - Electronic, vibrational and rotational energy levels: Relative population – Absorption and emission spectra – Selection rules – line widths – resolution and signal to noise ratio.

UNIT 2 UV-VISIBLE SPECTROSCOPY

9 Hrs.

Electromagnetic spectrum – Energy-Wavelength relationship – Introduction to UV-VIS spectroscopy – Beer-Lamberts Law – Instrumentation – Bands in UV-VIS spectrum – Possible electronic transitions – Types of electronic transitions based on selection rules – Characteristic absorption (λ_{max} and ϵ_{max}) – Factors influencing absorption – Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Hypochromic shift, Hyperchromic shift.

UNIT 3 IR AND RAMAN SPECTROSCOPY

9 Hrs.

Introduction to IR spectroscopy – Principle, types of stretching and bending vibrations, vibrational frequencies – Instrumentation – Bands in IR spectrum – Selection rules – Identification of organic molecules from characteristic absorption bands.

Raman spectroscopy – Principle – Raleigh and Raman scattering – Stoke's and antistoke's line – Differences between IR and Raman spectroscopy – Mutual exclusion principle – applications.

UNIT 4 NMR SPECTROSCOPY

9 Hrs.

Principle of nuclear magnetic resonance – Instrumentation – Shielding mechanism - Chemical shift – Multiplicity – Spin-spin coupling and coupling constants – Splitting of signals - Deuterium labeling – Interpreting the NMR spectra of some organic molecules.

UNIT 5 MASS SPECTROMETRY

9 Hrs.

Basic principles of mass spectrometry – Molecular ion peak – Base peak – Isotopic peak – Metastable peak and their uses – Fragmentation – m/z values of various fragments – Nitrogen rule - McLafferty rearrangement - Interpreting the mass spectra of some organic molecules – Instrumentation – Combined application in identifying organic compounds.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Examine the principles of spectroscopy for absorption and emission spectra
- CO2: Analyze the UV-Visible spectral transitions of molecules
- CO3: Examine the principles of IR and Raman spectroscopic techniques
- CO4: Apply the principles of NMR spectroscopy to interpret NMR spectra of organic molecules
- CO5: Analyze the Mass spectra of organic molecules
- CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Banwell C. N., Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1983.
2. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
3. Barrow G. M., Introduction to Molecular Spectroscopy, McGraw-Hill, 1962.
4. Willard H. H., Merritt Jr. L. L., Dean J. A., and Settle Jr. A. F., Instrumental methods of analysis, 6th Edition, Van Nostrand, 1981.
5. Kemp W., Applications of Spectroscopy, English Language Book Society, 1987.
6. Skoog D. A., West D. M., Holler f. J., and Crouch S. R., Fundamentals of Analytical Chemistry, 9th Edition, Wadsworth Publishing Co. Inc., 2012

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

SCYA 3005	CHEMISTRY OF NATURAL PRODUCTS	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To learn about the isolation of alkaloids and structural elucidation of coniine, nicotine, piperine and papaverine.
- To emphasize on the isolation of terpenoids and structural elucidation of citral, menthol, geraniol, camphor and vitamin A.
- To recognize the biological importance of purines and pyrimidines in organic reactions.
- To emphasize on the structural determination of cyanidine chloride and Quercetin .
- To impart an insight into structural details of hormones and Vitamins.

UNIT 1 ALKALOIDS

9Hrs.

Classification, isolation, purification, general methods of structure determination - functions of alkaloids. Structural elucidation of coniine, nicotine, piperine and papaverine.

UNIT 2 TERPENOID AND CAROTENOID

9 Hrs.

Terpenoids: Introduction, classification, Isoprene rule - General methods of determining structure – Structural elucidation of citral, menthol, geraniol and camphor.

Carotenoids: Introduction, geometrical isomerism, structure determination and synthesis of β -carotene and vitamin A.

UNIT 3 PURINES AND PYRIMIDINES

9 Hrs.

Purines: Introduction, biological importance - Structure and synthesis of Uric acid, Xanthine and Caffeine - Pyrimidines: Introduction, Structure and synthesis of Uracil and Thymine.

UNIT 4 ANTHOCYANINS AND FLAVONES

9 Hrs.

Anthocyanins: Introduction to anthocyanins - Structure and general methods of synthesis of anthocyanins - Cyanidine chloride: structure and determination – Flavones and Isoflavones: Structure and determination of flavone and flavonoids - Quercetin: Structure determination and importance.

UNIT 5 HORMONES AND VITAMINS

9 Hrs.

Hormones: Introduction - Difference between hormones and vitamins. Classification - Structure and functions of steroid hormones: Androsterone - Progesterone - Testosterone - Estrone. Adrenocortical hormones: Cortisone. Vitamins: Structure and importance of Vitamin D - Folic acid - Nicotinamide.

Max.45 Hours

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1:Elaborate on the methods and structural elucidation of Coniine, Nicotine, Piperine and Papaverine.

CO2:Explain on the structural elucidation of citral, menthol, geraniol, camphor and vitamin A.

CO3:Examine the structure and synthesis of uric acid, Xanthine, caffeine, Uracil and Thymine.

CO4:Discuss on the general methods of synthesis of anthocyanins.

CO5:Explain on the structural elucidation of cyanidine chloride and Quercetin.

CO6:Summarize the structure and functions of hormones and Vitamins..

TEXT / REFERENCE BOOKS

1). O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.

2). L. Finar, Organic Chemistry, Vol-2, 6th ed., Pearson Education Asia. 2004.

3). Gurdeep Chatwal and Anand, Chemistry of Natural Products Vol 1 & 2, Himalayan Publishing Co, 2001.

4). Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

SCYA 3001	Analytical Chemistry	L	T	P	Credits	Total marks
		3	1	0	3	100

COURSE OBJECTIVES

- To enable the students learn the principles of separation and purification techniques.
- To understand the principles of various chromatographic techniques.
- To construct the techniques for separation of metal ions using various chromatographic methods.
- To develop the skill of learning various thermal methods.
- To discuss the basic principle of polarimetry and amperometry methods.

UNIT 1 SEPARATION AND PURIFICATION TECHNIQUES

9 Hrs.

Principles involved in the separation of precipitates, solvent extraction and electrophoresis. Purification of solid organic compounds, extraction - use of immiscible solvents, soxhlet extraction, crystallization, use of miscible solvents, fractional crystallization, sublimation. Purification of liquids, experimental techniques of distillation, fractional distillation, vacuum distillation, steam distillation, tests for purity.

UNIT 2 CHROMATOGRAPHY I

9 Hrs.

Principles adsorption, thin layer, partition and paper. Chromatography column chromatography, adsorbents, preparation of column, adsorption, elution, recovery of substance and applications. TLC - choice of adsorbent and solvent, preparation of chromatogram and applications, R_f value. Paper chromatography, Solvents used and principles, factors affecting R_f value, separation of amino acid mixtures. Radial paper chromatography.

UNIT 3 CHROMATOGRAPHY II

9 Hrs.

Ion exchange chromatography – principle, resins, action of resins, experimental techniques, applications, separation of Zn-Mg, Co-Ni, Cd-Zn, Chloride, bromide. Gas chromatography and high pressure liquid chromatography – principles, Detectors, experimental techniques, instrumentation and applications.

UNIT 4 THERMAL ANALYSIS

9 Hrs.

Thermal analytical methods - Principle involved in thermogravimetric analysis and differential gravimetric analysis, discussion of various components with block diagram, characteristics of TGA and DTA, factors affecting TGA and DTA curves, thermometric titrations.

UNIT 5 POLAROGRAPHY

9 Hrs.

Principle, concentration polarization, dropping mercury electrode, advantages and disadvantages, convection, migration and diffusion currents, ilkovic equation (derivation not required) and significance, experimental assembly, electrodes, capillary solutions, current voltage curve, oxygen wave, influence of temperature and agitation on diffusion layer, polarography as an analytical tool in quantitative and qualitative analysis. Amperometry - basic principles and uses. Polarimetry principle – instrumentation, comparison of strengths of acids, estimation of glucose.

Max.45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Apply the principles of separation and purification to the miscible and immiscible liquids
- CO2: Examine the principles of adsorption in paper and thin layer chromatography
- CO3: Apply the principles of chromatography to the GC and HPLC techniques
- CO4: Examine the principles of thermal methods to TGA, DTA and thermometric titration techniques
- CO5: Apply the polarization principles to the polarography and polarimetry techniques
- CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Concise Inorganic Chemistry – J.D. Lee – 3rd Edition, Von Nostrand
2. Inorganic Chemistry – P. L. Soni – Sultan Chand
3. Inorganic Chemistry – Pun and Sharma Nagin
4. Inorganic Chemistry – Modan S. Chand
5. Advanced Inorganic Chemistry – Cotton and Wilkinson
6. A Textbook of Inorganic Chemistry – A.K. De – New Age
7. Industrial Chemistry- B.K. Sharma – Goel Publications
8. General and Inorganic Chemistry Part I Sarkar, Books and Allied (P) Ltd
9. General and Inorganic Chemistry Part II Sarkar, Books and Allied (P) Ltd
10. Chemical Methods for Environmental Analysis Ramesh and Anbu, Macmillan

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

SCYA 3009	INDUSTRIAL CHEMISTRY			L	T	P	Credits	Total Marks
				3	1	0	4	100

COURSE OBJECTIVES:

To enable a student to understand:

- The generation of energy from various types of fuels and electrochemical power sources.
- The use of chemicals in improvement of agricultural crops.
- Methods employed for purification of water for industries.
- Manufacturing processes of industrially important materials.

UNIT 1 INDUSTRIAL FUELS AND EXPLOSIVES

9 Hrs

Classification of fuels – Solid fuels: Coal: Types, properties and uses – Liquid fuels: Petroleum – Refining of petroleum, fractions and their uses – Fluidized bed catalytic cracking – Knocking and octane number – Gaseous fuels: Natural gas; LPG; Gobar gas: production, composition and uses.

Explosives: Definition and requirements – Classification of explosives – Preparation of gun powder, lead azide, cordite, TNT, RDX, dynamite – Classification of rocket propellants.

UNIT 2 ELECTROCHEMICAL INDUSTRY

9 Hrs

Production of materials like chlorine, caustic soda, sodium chlorate – Batteries: Zinc-carbon cell, alkaline battery, lead-acid battery, NICAD battery – Fuel cells: Hydrogen-oxygen fuel cell – Solar cells: Photovoltaic cell – Paints: Pigment volume concentration, constituents of paints and their functions – Types of varnishes.

UNIT 3 AGROCHEMICALS

9Hrs

Fertilizers: Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts – Insecticides: stomach poisons, contact insecticides, fumigants – Pesticides: Mode of action and synthesis of common pesticides like gammexane, DDT, aldrin, Parathion, Malathion. Herbicides: Manufacture of 2,4-D and 2,4,5-T – Fungicides: Preparation of Bordeaux mixture.

UNIT 4 WATER TREATMENT

9 Hrs

Sources of water – Hardness of water – Water softening methods: Zeolite process, demineralisation process – Desalination: Reverse osmosis and electrodialysis.

Sugar industry: Refining and grading of sugar - Sugar substitute: Saccharin and aspartame.

Leather industry: Curing, preservation and tanning of hides and skins – Treatment of tannery effluents.

Cleansing agents: Preparation of toilet and washing soaps – Cleansing action of soaps.

UNIT 5 CERAMIC INDUSTRY

9 Hrs

Cement: Manufacture by wet process and dry process – Setting and hardening of cement – Water proof cement – White cement.

Glass: Composition and properties of glass – Manufacture of glass – Types of glasses.

Composites: Definition – Metal-matrix composites – Fiber reinforced composites – ceramic matrix composites.

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1-To understand the classification of fuels and explosives and their requirements.

CO2-To learn the different types of batteries and fuel cells.

CO3- To understand the composition of different types of important fertilizers.

CO4- To study the different softening methods of hard water and its application in different industries.

CO5-To learn the composition of cement and glass and their properties.

TEXT / REFERENCES

1. Norris Shreve, R. and Joseph A. Brink, Jr. Chemical process industries, McGraw-Hill, 4th Ed (1997).
2. Subba Rao, N. S. Biofertilizers in Agriculture, Oxford and IBH Publishing Co. (1982).
3. Jain, P. C. and Jain, M. Engineering Chemistry, 14th Ed.; Dhanpat Rai and Sons, (2016).
4. Sheik Mideen, A. Engineering Chemistry I and II, J B Publications (2015).
5. Kuriakose, J. C. and Rajaram, J. Chemistry in Engineering and Technology Volume 1&2, Tata McnGraw Hill. (1988).
6. Sharma, B. K. Industrial Chemistry, Oxford and IBH Publishing Co. (1981).

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

SCYA 1301	GENERAL CHEMISTRY III	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To learn the chemical reactions and theories of acids and bases, oxidation reduction processes and electron transfer reactions.
- To understand the properties and chemical reactions of s-block elements and their compounds.
- To learn the preparation, nomenclature and structure of halogen compounds, dienes and alkynes.
- To understand stereochemistry of organic compounds from geometric isomerism, conformers and their interconversions.
- To study the solution laws and properties of binary solutions and dilute solutions

UNIT 1 ACIDS AND BASES

9 Hrs.

Types of chemical reactions- Acid-base, oxidation-reduction, electron transfer and double decomposition reactions. Balancing chemical reactions by oxidation number and ion electron method. Theories of acids and bases- Arrhenius theory - Bronsted-Lowry theory - Lewis theory - solvent system - Lux-Flood definition and Usanovich definition, HSAB concept.

UNIT 2 s-BLOCK ELEMENTS

9 Hrs.

Chemical properties of the group metals: reaction with water, air, nitrogen; uses of s-block metals and their compounds. Compounds of s-block metals: oxides, hydroxides, peroxides, superoxides - preparation and properties; oxo salts - carbonates, bicarbonates, nitrates; halides and polyhalides; anomalous behavior of Li, Be and B, extraction of beryllium. Complexes of s-block metals: complexes with crown ethers, biological importance of sodium and potassium.

UNIT 3 ALKENES, DIENES AND CYCLOALKENES

9 Hrs.

Structure and Nomenclature-Methods of Preparation-Dehydration of alcohols, dehydrohalogenation of alkyl halides-Elimination reactions- Hoffmann and Saytzeff rules- dehalogenation-Physical and Chemical Properties-Addition of hydrogen, halogen, hydrohalogenation(Markovnikov's and Anti-Markovnikov's rule)- Epoxidation, Ozonolysis, Polymerization-.Dienes-Conjugated, Non-conjugated dienes, cumulative dienes-Structure-1, 3-butadiene-Preparation and properties-Diels Alder reaction.Cycloalkenes- Structure and Nomenclature- Methods of preparation-Physical and chemical properties cyclopentadiene and cyclohexene.

UNIT 4 ALKYNES

9Hrs

Nomenclature- Preparation- Dehydrohalogenation, Dehalogenation, alkylation of acetylene-Physical properties, Chemical properties- Electrophilic addition Addition of halogen, halogen acids- Nucleophilic addition: Addition of HCN, NH₃, acids and alcohols- Oxidation- Hydroboration- Reduction- Metal-ammonia reactions-Formation of sodium or lithium alkynide.

UNIT 5 SOLUTIONS

9Hrs

Types of solutions- Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law-ideal and non-ideal solutions- Binary solutions: fractional distillation-Azeotropic mixture-immiscible liquids-steam distillation-partially miscible liquids-critical solution temperature-phenol-water system-aniline-hexane system-Nicotine-water system. Dilute solutions: Colligative properties, relative lowering of vapour pressure, osmosis, Law and osmotic pressure, Thermodynamic derivation of elevation of boiling point and depression in freezing point. Determination of molecular masses using the above properties.

Max.45 Hrs.

COURSE OUTCOMES

On successful completion of the course, student will be able to

CO1: Examine the mechanism involved in various theories of acids and bases

CO2: Assess the structure and reactivity of s-block elements

CO3: Examine the physical and chemical properties of alkenes, dienes and cycloalkenes

CO4: Apply the electrophilic and nucleophilic addition mechanism to the alkyne reactions

CO5: Apply the laws of solutions to determine the colligative properties for dilute solutions and critical solution temperature for binary solutions

CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
5. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
6. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
7. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)

SCYA 1401	GENERAL CHEMISTRY-IV	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To understand the structure and properties of important boron and carbon compounds
- To learn the trend observed for the nitrogen and oxygen groups and understand the structural importance in forming nitrogen and phosphorous compounds.
- To learn the preparation of Nitrogen and Oxygen group elements
- To appreciate the concept of stereochemistry and optical isomerism
- To learn the properties of colloidal systems, emulsions and macromolecules

UNIT 1 BORON AND CARBON GROUP ELEMENTS

9 Hrs.

Group 13 (Boron group): Extraction of B and Si - types of compounds - reactions involving Boron - Compounds of boron with oxygen - boron sesquioxide – borates – borax; Boron hydrides - reaction with ammonia, hydroboration, structure of boranes – uses of Boron hydrides – Aluminium - amphoteric behaviour - aluminates.

Group 14 (Carbon group): Catenation and heterocatenation - allotropes of carbon - graphite, diamond, fullerenes and carbon nanotubes (structural features and uses); carbides - salt-like carbides, interstitial carbides, covalent carbides; Silicates - ortho-, pyro-, cyclic-, chain-, sheet - three dimensional silicates - properties and structures - silicates in technology - alkali silicates.

UNIT 2 NITROGEN AND OXYGEN GROUP ELEMENTS

9 Hrs.

Group-15 (Nitrogen group): metallic and nonmetallic character - compounds of Nitrogen - N_2H_4 , NH_2OH , HN_3 - Phosphorous compounds - halides and oxohalides. Group-16 (Oxygen group): Types of oxides - basic oxides, amphoteric oxides, acidic oxides, neutral oxides. Oxides of sulphur - SO_2 , SO_3 - oxyacids of sulphur - thionic acid series - peroxyacid series – oxohalides - thionyl compounds (methods of preparation and properties).

UNIT 3 STEREOCHEMISTRY-I

9 Hrs.

Geometrical Isomerism - Cis and trans, syn and anti, E and Z notations - Cis-trans interconversion - Conformational isomerism: Conformers, dihedral angle, torsional strain - Conformational analysis of ethane and n-butane, conformers of cyclohexane (Chair, boat and skew boat forms), axial-equatorial positions and their interconversions, conformers of mono and disubstituted cyclohexanes - diaxial interactions.

UNIT 4 STEREOCHEMISTRY – II

9 Hrs.

Optical isomerism – Chirality – Measurement of optical activity – Specific rotation – Enantiomerism and Diastereomerism - Wedge, Fischer, Newmann and Sawhorse projection formulae — Difference between Configuration and Conformation - Absolute and Relative configuration - D and L notation - Cahn-Ingold-Prelog's rules – R and S notation – Optical isomerism in compounds containing more than one carbon atom – Isomerism in tartaric acid - Racemic modification – Racemization - Resolution of racemic mixtures – Asymmetric synthesis (definition only) - Walden inversion.

UNIT 5 COLLOIDS AND MACROMOLECULES

9 Hrs

Colloidal systems – classification – preparation – purification of colloids - Properties of colloids: Kinetic, optical and electrical properties. Emulsions: Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium - applications of colloids. Macromolecules - Different types of polymers – classification of polymers. Molecular weight of polymers – number average and weight averages – determination of molecular weight of polymer – osmotic pressure and light scattering methods.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1: Examine the properties of boron and carbon group elements
 CO2: Analyze the metallic and non-metallic character of nitrogen group elements and nature of oxides of oxygen group elements
 CO3: Apply the concept of conformation analysis to the conformations of acyclic and cyclic compounds
 CO4: Apply the configurational rules for assigning the absolute and relative configuration to organic molecules
 CO5: Examine the properties and industrial applications of colloids and macromolecules
 CO6: Evaluate the basic concept of chemistry to real world applications

TEXT / REFERENCE BOOKS

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
4. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
5. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
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END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 Marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 Marks.

80 Marks

(Out of 100 Marks, maximum of 10% problems may be asked.)